

CLAIMS

1. A surface emitting laser performing surface emission of laser light, comprising:

an active layer disposed on a semiconductor substrate; and
a pair of electrodes for injecting carriers into the active layer;

wherein one of said electrodes comprises a single electrode layer, and injection of current from said one electrode into the active layer is carried out with different current densities for a center portion of said one electrode and for a peripheral portion thereof.

2. A surface emitting laser as defined in Claim 1 including:

a semiconductor layer laminated body including the active layer, which is obtained by laminating plural semiconductor layers on the semiconductor substrate;

wherein the area density in a region where the electrode layer contacts the semiconductor layer laminated body differs between the center portion of the electrode layer and the periphery portion thereof.

3. A surface emitting laser as defined in Claim 1 wherein plural fine holes are formed in the electrode layer constituting said one electrode so that the occupation density of the fine holes

differs between the center portion of said one electrode and the peripheral portion thereof.

4. A surface emitting laser as defined in Claim 1 wherein the resistance value of the electrode layer constituting said one electrode differs between the center portion of said one electrode and the peripheral portion thereof.

5. A surface emitting laser as defined in Claim 1 further including:

a semiconductor layer laminated body including the active layer, which is obtained by laminating plural semiconductor lasers on the semiconductor substrate; and

a resistive layer disposed between the semiconductor layer laminated body and the electrode layer constituting said one electrode;

wherein the resistance value of the resistive layer differs between a portion corresponding to the center portion of said one electrode and a portion corresponding to the peripheral portion of said one electrode.

6. A surface emitting laser as defined in Claim 1 further including:

a semiconductor layer laminated body including the active layer, which is obtained by laminating plural semiconductor

layers on the semiconductor substrate; and

a resonator for amplifying the light generated in the active layer to generate laser oscillation, said resonator comprising a reflection layer included in the semiconductor layer laminated body, and an external mirror disposed separately from the semiconductor layer laminated body so as to be opposed to the reflection layer.

7. A surface emitting laser as defined in Claim 6 wherein said external mirror is a partial transmission mirror both surfaces of which are concave in shape.

8. A surface emitting laser as defined in Claim 1 further including:

a semiconductor layer laminated body including said active layer, which is obtained by laminating plural semiconductor layers on the semiconductor substrate; and

said semiconductor layer laminated body including an over-saturation absorber for absorbing over-saturated carriers in the active layer, said absorber being disposed in the vicinity of the active layer.

9. A surface emitting laser as defined in Claim 1 wherein the oscillation wavelength of the surface-emitted laser light is within a range of 430~455nm.

10. A surface emitting laser as defined in Claim 1 wherein the oscillation wavelength of the surface-emitted laser light is within a range of 630~650nm.
11. A surface emitting laser as defined in Claim 1 wherein the oscillation wavelength of the surface-emitted laser light is within a range of 510~550nm.
12. A surface emitting laser as defined in Claim 6 including a non-linear optical member for converting the wavelength of laser light, said optical member being disposed between the external mirror and the active layer.
13. A surface emitting laser as defined in Claim 1 including:
a semiconductor layer laminated body including the active layer, which is obtained by laminating plural semiconductor layers on the surface of the semiconductor substrate; and
said semiconductor substrate having a concave part which is formed by etching a portion of the substrate at its rear surface, up to a position near the surface of the active layer.
14. A semiconductor laser device comprising a semiconductor laser for emitting laser light, and a wavelength conversion element for converting the wavelength of the laser light emitted

from the semiconductor laser,

said semiconductor laser being the surface emitting laser defined in Claim 1.

15. A laser module obtained by integrating plural semiconductor lasers in a single package,

each of the plural semiconductor lasers being the surface emitting laser defined in Claim 1.

16. A laser module as defined in Claim 15 wherein said plural semiconductor lasers are arranged so that each semiconductor laser is positioned at an apex of a regular polygon the center of which matches the center of the package.

17. A laser projector comprising a semiconductor laser for emitting laser light, and a projection optical system for projecting the laser light emitted from the semiconductor laser,

said semiconductor laser being the surface emitting laser defined in Claim 1.

18. A laser projector as defined in Claim 17 wherein said surface emitting laser emits laser light in which a vertical mode spectrum is in a multimode.

19. A laser projector as defined in Claim 17 wherein said

surface emitting laser emits laser light in which the substantial width of a vertical mode spectrum is 1nm or more.

20. A surface emitting laser performing surface emission of laser light comprising:

an active layer disposed on a semiconductor substrate; and
a pair of electrodes for injecting carriers into the active layer;

wherein one of said electrodes is divided into plural electrode parts, and

a laser driving voltage on which a radio frequency component is superposed is applied to at least one of the plural electrode parts.

21. A surface emitting laser as defined in Claim 20 wherein said divided plural electrode parts are arranged substantially uniformly around the emission center of the laser light.

22. A surface emitting laser as defined in Claim 20 wherein injection of current from each electrode part to the active layer is carried out so that the current density increases toward a region near the emission center of the active layer.

23. A surface emitting laser as defined in Claim 20 wherein a modulated laser driving voltage is applied to at least one of the

plural electrode parts.

24. A surface emitting laser as defined in Claim 20 wherein plural semiconductor laser parts constituted by the respective electrode parts are driven with different injection currents.

25. A surface emitting laser as defined in Claim 20 including:
a semiconductor layer laminated body including the active layer, which is obtained by laminating plural semiconductor layers on the surface of the semiconductor substrate; and
said semiconductor substrate having a concave part that is formed by etching a portion of the substrate at its rear surface, up to a position near the surface of the active layer.